NASA TECH BRIEF

A Fast-Neutron Spectrometer of Advanced Design

The problem:

To design and develop a fast-neutron spectrometer for spectral measurements requiring a combination of good resolution, high efficiency, and rapid response. Accurate measurements are required of fast-neutron fluxes of $10^8/cm^2/sec$ to $10^{10}/cm^2/sec$, within a gamma field as high as $1.5 \times 10^6 R/hour$ and a time limit of 5 seconds.

The solution:

An instrument that combines He^3-filled proportional counters with solid-state detectors to achieve the properties of high efficiency, good resolution, rapid response, and effective gamma-ray rejection.

How it's done:

Using the $He^3(n,p)T$ reaction as a neutron converter, if the total energy of the secondary particles, the proton and triton, is absorbed, the recorded spectrum is easily interpreted. Since this reaction has a Q-value of 0.760 Mev, the energy of a recorded neutron is well above most background (interference), and a resolution of 30 to 50 Kev can be achieved. Neutrons whose absolute energies are 2 to 3 times this value (as low as 100 Kev), produce peaks that can be resolved from those peaks produced by thermal neutrons. A number of advantages are realized if a method that makes use of the volume of He^3 gas present in the solid-state sandwich spectrometer is developed. The He^3 gas is used as a proportional counter. Resolution is improved by adding the energy deposited in the proportional counter to that absorbed in the solid-state charged-particle detectors. Coincidence between the solid-state detector and the proportional counter results in greatly reduced background.

An extension of the above use of He^3 gas as a proportional counter, is to divide the volume into two proportional counters. This arrangement permits the use of particle identification techniques to eliminate gamma interactions, He^3 recoils, deuterons from the $He^3(n,d)D$ reaction, alpha particles from the $Si^{28}(n,a)Mg^{25}$ reaction, and many of the protons from the $Si^{28}(n,p)Al^{28}$ reaction.

A neutron spectrometer has been developed to incorporate the above considerations. The He^3 volume is divided into two proportional counters separated by a series of wires that defines the electric field. Coincidence between the two proportional counters is achieved, and a proton is identified through its $(dE/dX)\,xE$ product.

Note:

Inquiries concerning this invention may be directed to:

Technology Utilization Officer
Marshall Space Flight Center
Huntsville, Alabama 35812
Reference: B66-10555

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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Category 01